DEVELOPING A PREVENTIVE PRUNING PROGRAM: YOUNG TREES

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Introduction

Trees growing in urban and suburban landscapes offer many benefits to the community. However, when a tree or part of a tree breaks, it can cause extensive damage to people and or property (Figure 1). A preventive pruning program is an important tool to minimize the risks of tree defects. The most common defects are codominant stems and aggressive low branches that either split from the tree or result in large pruning cuts upon removal (Figure 2). Problems such as these result in tree stress, reduce the life span of the tree, and place people and property at risk. Preventive pruning helps to promote good structure, making trees more resistant to storms and other natural forces. A research study in 2006 suggests that pruning trees significantly reduces trunk movement and damage when exposed to 120-mph winds.

Trees with good structure are characterized by a single dominant leader, strong branch unions without bark inclusions and a balanced canopy (Figure 3). Preventive or structural pruning is a process that can help to promote these attributes in trees.

Figure 1

A large limb fell on this car and broke the windshield during a storm. Pruning may have prevented this damage.

Figure 2

The codominant stem (top) split from the tree because of a weak branch connection and included bark. Proper structural pruning could have prevented this defect from failing. The large lower limbs (bottom) of these mahogany trees are too close to the ground and will have to be removed soon to provide for clearance under the canopy. Removing large branches like this can initiate decay and slows growth. Prune earlier to prevent this poor form from developing.

A good structure (top) is characterized by a single dominant leader, and branches that are spaced and not touching throughout the canopy. A bad structure (bottom) has many dominant stems and branches clustered together.

Determine Your Objectives

The major objective of preventive structural pruning is to direct the growth of the tree so that it forms a sustainable structure. This is accomplished by pruning stems and branches that are not growing in the correct direction or position.

Structural issues that cause trees to fail
Codominant stems
Included bark
Unbalanced canopy
Lions-tailing or over-lifting
Large lower limbs

Correction of Structural Issues

Codominant Stems and Included Bark

Codominant stems are stems of equal size originating from the same point on the tree. Included bark is bark pinched between two stems creating a weak union. Codominant stems with a 'V' shaped union are often accompanied by included bark (Figure 4). This union is weak because the bark inclusion prevents any physical connection between the two stems. Instead of overlapping wood creating a strong connection, the two stems push each other apart as they grow and a crack develops. Researchers at the University of Florida have visited several hurricane sites, and found time and time again that trees failed due to structural issues like codominant stems and bark inclusions.

Strong branch unions are 'U' shaped and have a prominent collar (Figure 5). The collar is a swelling formed by overlapping trunk and branch wood. This forms a strong union resistant to breakage.

Unbalanced Canopy

An unbalanced canopy occurs when one side of the tree canopy is much heavier than the other, or when most of the canopy weight is at the tips of branches. The later is a product of lions-tailing or over-lifting, a poor pruning practice that removes all of the live foliage along the lower and interior parts of the main branches (Figure 6). Lions-tailing is generally accepted by professionals as a poor pruning practice that makes trees more susceptible to wind damage. Lions-tailing encourages more growth at the tips of the branches, resulting in a taller and wider tree. This results in foliage exactly where it is unwanted; that is, higher off the ground. Lions-tailing is often performed as a type of thinning; however, this type of pruning routinely encourages sprouting along the main branches and the canopy quickly fills back in with foliage. These sprouts often have weak connections to the stems and break easily in storms. In addition, lions-tailed trees that are damaged in storms are difficult to restore because the branches arborists would normally cut back to have already been removed.

Large Lower Limbs

Removal of lower limbs is important in order to provide clearance for pedestrian and vehicular traffic. Too often lower limbs are removed only when they have become large and have started to droop, many years after planting. Removal of large branches can initiate decay in the trunk, especially in species prone to decay (Figure 7). Large limbs left to grow may also develop structural defects such as excessive end weight. This defect can increase the likelihood of branch failure. It is important to keep in mind that low branches on young trees are temporary and will have to be removed in the future. Manage lower branches to prevent structural defects from forming.

Figure 4

Codominant stems with included bark have weak connections and often split apart in storms (inset).

Figure 5

Strong branch connections have a 'U' shaped union (top) and a prominent branch collar. Some species also show a very distinct branch bark ridge (bottom).

Figure 6

Lions-tailed trees have an unbalanced canopy since all of the foliage is at the tips of the branches. These trees are more susceptible to storm damage and difficult to restore once they are damaged.

Pruning to Promote Strong Structure

Developing a preventive pruning program requires that managers be familiar with the techniques of structural pruning. Structural pruning should be practiced for the first 15 to 25 years of a tree's life. This is the amount of time required to establish strong structure in the canopy and will help to make the tree more resistant to storm damage (Figure 8). In structural pruning, reduction and removal cuts are used to slow the growth of large or rapidly growing branches that compete with the leader. This encourages the one stem you chose as the leader to grow faster.

Components of Structural Pruning	
1	Develop or maintain a dominant leader
2	Identify the lowest branches in the permanent canopy
3	Prevent branches below the permanent canopy from growing too large
4	Keep all branches less than one half the trunk diameter
5	Space main branches along one dominant trunk
6	Suppress growth on branches with included bark

Component 1

Developing or Maintaining a Dominant Leader

Developing a dominant leader starts by identifying the stem that will make the best leader; typically it is the largest stem. This might be easy for some trees and more difficult in others. If all stems are about the same diameter, pick the one that is closest to the center of the canopy as the leader. Then determine which stems are competing with that leader, and decide where to shorten these competing stems (Figures 8 and 9).
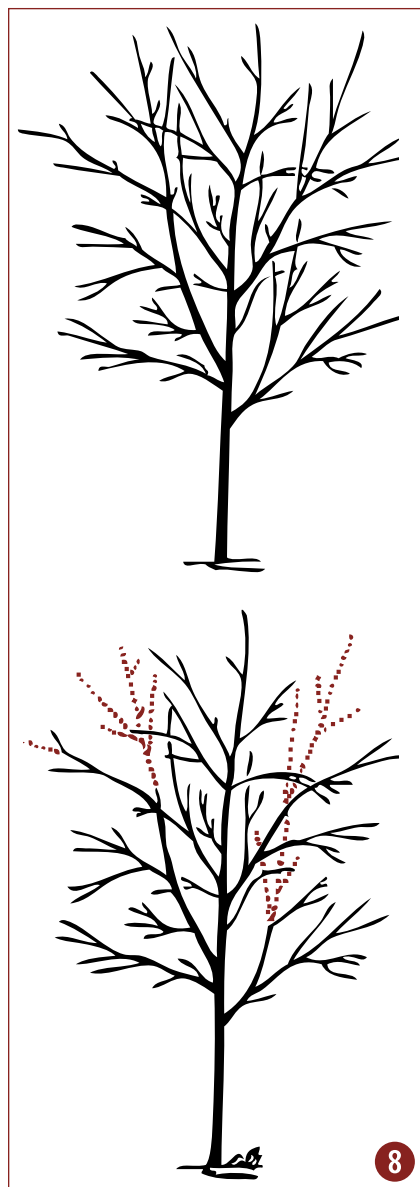
Before | After

Figure ⑨

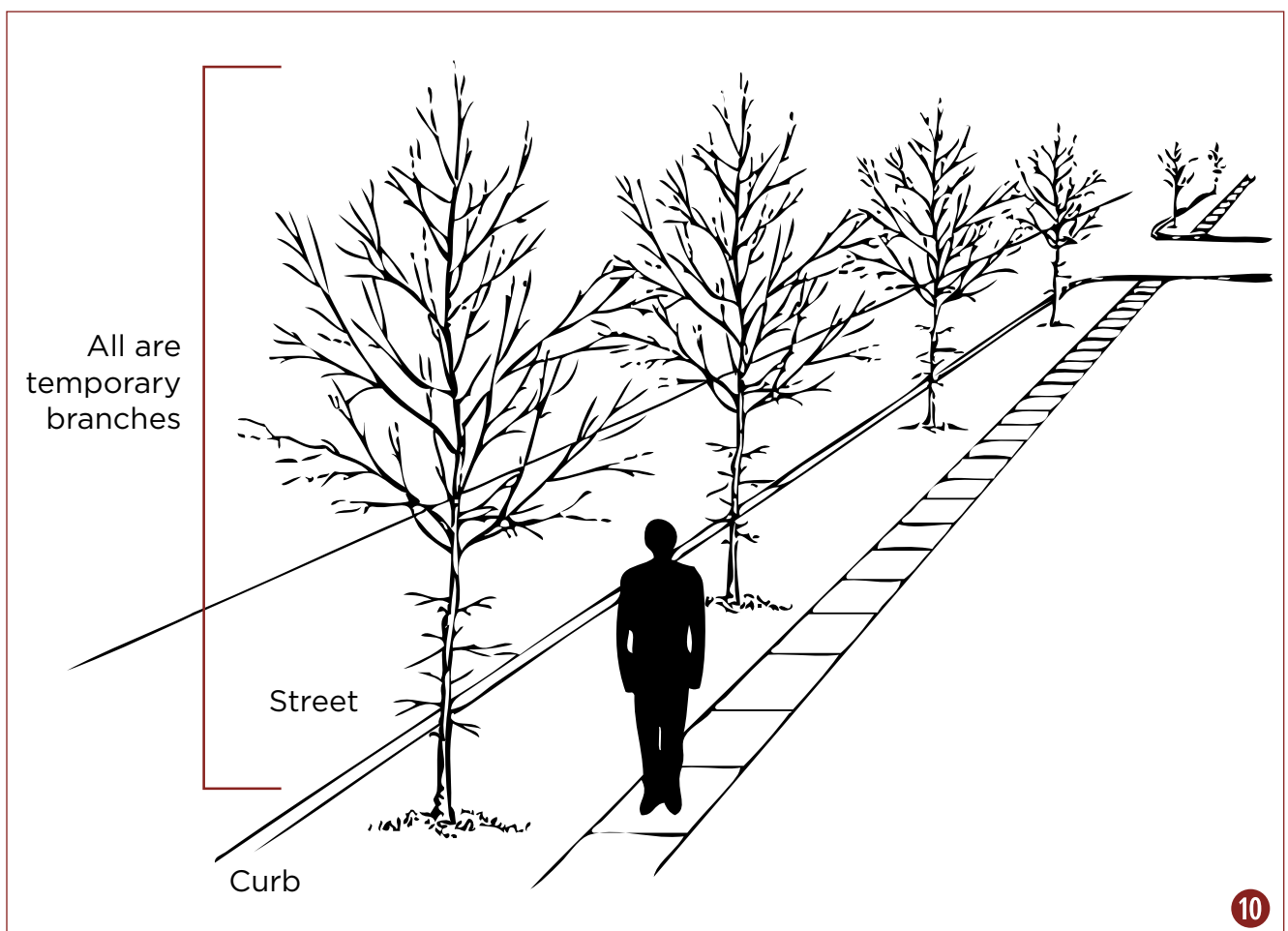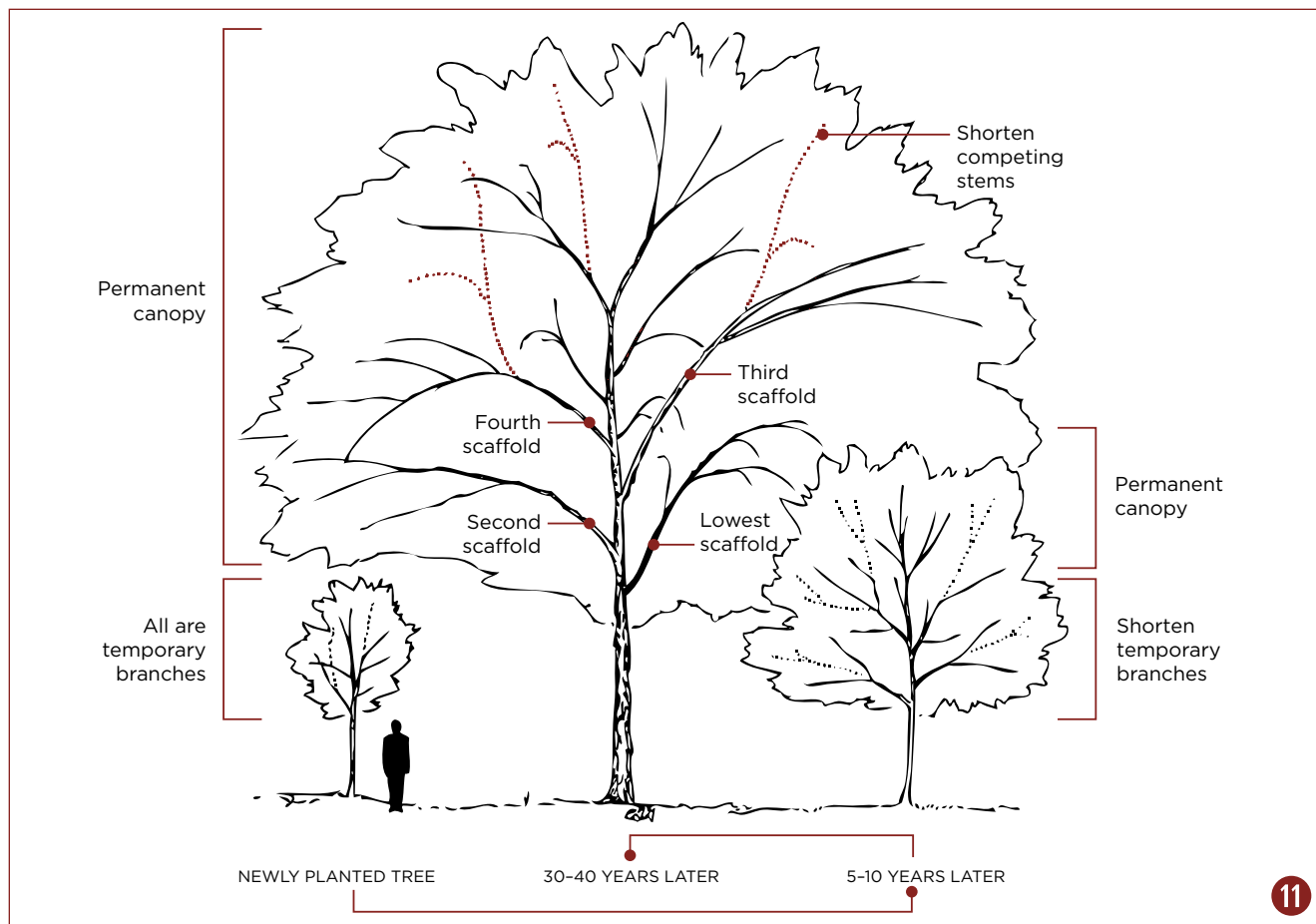Before and after structurally pruning a young live oak. Notice the arrow indicating where the stem on left side of the leader has been reduced.

Figure ⑩

All existing branches on these recently planted trees along a street will eventually have to be removed in order to provide clearance for buses, garbage trucks, and tractor trailers.

All are temporary branches

Street

Curb

Permanent canopy

Shorten competing stems

Third scaffold

Fourth scaffold

Permanent canopy

Second scaffold

Lowest scaffold

All are temporary branches

Shorten temporary branches

NEWLY PLANTED TREE

30–40 YEARS LATER

5–10 YEARS LATER

11

Component 2

Identifying the Lowest Branches in the Permanent Canopy

First, recognize that branches do not change their position on the trunk as the tree grows. In fact, it may be surprising for some to realize that all branches on trees with less than about 4" caliper will eventually be removed. Identifying the lowest branches in the permanent canopy will facilitate management of lower temporary branches (Figures 10 and 11).

Component 3

Prevent Branches below the Permanent Canopy from Growing Too Large

The lowest permanent branch on many shade trees should be at least 15 to 20 feet off the ground; all lower branches are eventually removed under ideal management. Lower branches should be subordinated (reduced) early to prevent them from becoming too large. This prevents the tree manager from having to make large pruning wounds on the trunk. We do this with reduction cuts to slow growth on these aggressive low branches. This helps to push new growth higher up in the canopy, and will minimize the amount of large cuts that need to be made on the trunk.

Figure **11**

Structural pruning cycle over a period of 40 years. Notice how all of the branches on a newly planted tree and half of the branches on a 5– to 10-year-old tree are temporary. These branches are managed with reduction cuts to slow their growth and encourage more growth in the upper canopy, which is the part of the tree that will be around for a long time. In the maturing permanent canopy (center), the large scaffold branches have been identified and spaced evenly along the trunk by shortening or removing nearby branches.

Component 4

Keep All Branches Less than Half the Trunk Diameter

Branches more than one-half the diameter of the trunk lack a branch protection zone. This zone inside the branch union is rich in chemicals that inhibit spread of organisms and decay from the pruning wound into the trunk. Keeping branches less than half the trunk diameter ensures that the branch collar and branch protection zone remain intact.

Component 5

Space Main Branches along One Dominant Trunk

Ideally, main branches (also called scaffold limbs) should be spaced along the dominant leader in two or more rotations around the trunk so that no branch is directly above another (Figure 12). Spacing scaffold limbs allows for the trunk and leader to develop properly, gives the canopy a more balanced form, and reduces wind resistance.

Component 6

### Suppress Growth on Branches with Included Bark

Suppress growth on branches with included bark (Figure 13) to minimize the chance of breakage. As mentioned earlier, included bark is a structural defect that causes the union between branch and trunk to be very weak. Reduce branches with included bark to slow their growth until you are ready to remove them.

IDEAL SCAFFOLD BRANCH SPACING

Figure 12

Major scaffold branches on this mahogany tree (right) have been spaced evenly throughout the canopy so that no branch is directly above another, making the tree more structurally sound (left).

Figure 13

Variations of included bark on four different trees.
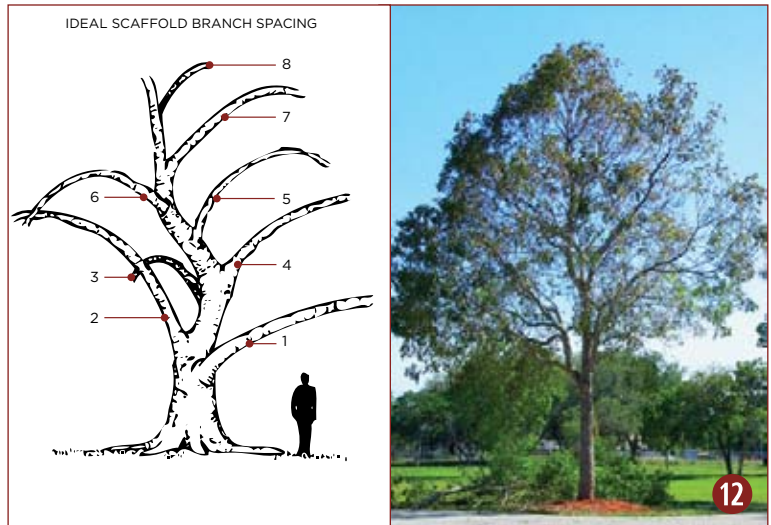
Determining Pruning Cycle and Pruning Dose

Pruning Cycle

The next step in developing a preventive pruning program is to determine the pruning cycle and pruning dose. A pruning cycle is the interval of time between each pruning event. The interval is affected by many factors. For instance, trees coming from a nursery with sound pruning practices will have a better structure to start out with than trees coming from a nursery with poor pruning practices. These low quality trees may require more pruning at a higher interval than the high quality trees.

Pruning cycles are also affected by growth rate, climate and species. In warm climates where trees grow faster, the intervals between pruning events should be shorter. Species that are prone to decay should also be pruned more often so that the need to make large cuts can be avoided. A typical pruning cycle for an active, preventive urban forestry pruning program in Florida is about three years. If the pruning cycle is too long, defects may become more severe. This results in having to make large pruning cuts, which can initiate pockets of decay in the trunk and branches. A pruning cycle of 3-5 years will require a higher pruning dose to achieve pruning objectives. Conversely, a pruning cycle of 1-2 years will require a smaller dose.

Suggested minimum pruning cycle
At planting
Year 2 or 3
Year 5 or 6
Year 8 to 10
Year 13 to 15

Pruning Dose

The pruning dose is the amount of live tissue removed from the entire tree at one pruning. More than this can be removed from any particular stem or branch. Typically, arborists estimate this by evaluating how much foliage was removed by the pruning. Customer expectations, size of stems and pruning cycle can influence the pruning dose (Table 1).

With a large pruning dose, you create large pruning wounds and a large void in the canopy, greatly encouraging growth in unpruned portions of the tree. Conversely, a small pruning dose creates smaller pruning wounds and a smaller void in the canopy, encouraging modest growth in the unpruned portions of the tree. Large pruning doses are typically employed only on young trees. Municipalities often use larger pruning doses where aesthetics is less of a concern. A smaller pruning dose along with a shorter pruning cycle is nicely suited for residential and commercial properties where aesthetics are more of a concern. Pruning dose on mature trees should be less than 10% unless there is a good reason (e.g. a major defect) to remove more.

Table 1. Uses of high and low pruning doses	
LOW PRUNING DOSE (5–20% of foliage removed)	**HIGH PRUNING DOSE (>20% of foliage removed)**
Mature or recently planted	Young, established trees
Cooler climates with short growing seasons	Warm climates with long growing seasons
Decay-prone species (poor compartmentalizers)	Decay-resistant species (good compartmentalizers)

Good compartmentalizers of decay (i.e. trees that resist decay following pruning) are those trees such as live oaks and mahogany that resist decay following an injury such as a wound or a pruning cut. When planning a pruning dose for your tree, you might want to set the maximum diameter of pruning cut smaller for a more decay-prone species (Table 2). The limit should be set for both reduction and removal cuts (Figures 14 and 15). Ideally, limit pruning cuts to 2-3 inches on decay-prone trees and 4-6 inches on decay-resistant trees. Large trees that are capable of forming heartwood will begin forming it as branch size increases to 8 inches or more. Exposing heartwood can initiate decay in certain species of trees. Professional arborists keep records of when species begin forming heartwood. This should help them decide when low interfering branches should be removed from trees.

| Table 2. Guidelines for determining maximum branch diameter to prune.		
BRANCH SIZE	**CONSEQUENCE OF REMOVAL**	**RECOMMENDED ACTION**
Less than 1/3 trunk diameter	Not many	Remove if needed
1/3 to 1/2 trunk diameter	Minimal	Shorten instead of removing
More than 1/2 trunk diameter	Some decay	Shorten instead of removing
Large enough to have heartwood	Defects more likely	Shorten instead of removing

Executing the Pruning Plan
Making Proper Pruning Cuts

An important component of a good preventive pruning program is making proper pruning cuts. There are two types of pruning cuts; these are reduction cuts (Figure 14), and removal cuts (Figure 15).

A good pruning cut begins with an undercut about 12 inches from the trunk (Figure 16). A top cut is then made further out from the limb or directly above the undercut. The majority of the limb is safely removed in this step without causing any damage to the tree. (Disregarding these first two steps could cause damage to the trunk because the branch is often too heavy to hold itself up causing tissue to tear down through the collar.) The last step is to remove the remaining stub with a final cut, being careful not to cut flush against the trunk. It is very important to leave the collar intact (Figure 17). A branch collar is a swollen area at the base of the branch where it joins the trunk. The tissue is rich in energy reserves and chemicals that hinder the spread of decay. Good pruning cuts avoid cutting into the collar and typically leave a round-shaped wound, whereas flush cuts are oval-shaped (Figure 18). The branch bark ridge is where trunk bark pushes up into the union as it grows against branch bark (Figure 19). This indicates a strong union. Never cut off the branch bark ridge since this removes the branch protection zone inside the collar. The protection zone helps prevent decay organisms from entering the trunk.

Bad cuts are called flush cuts and are unacceptable in a preventive pruning program (Figure 20). Flush cuts remove the top of the branch bark ridge, and prevent the wound from sealing over properly. Flush cuts typically expose more bark on top of the cut than on the sides and bottom. These cuts typically close first on the sides then on the top and bottom. Severe decay can occur behind flush cuts, especially when they are large in diameter.

Reduction cut

14

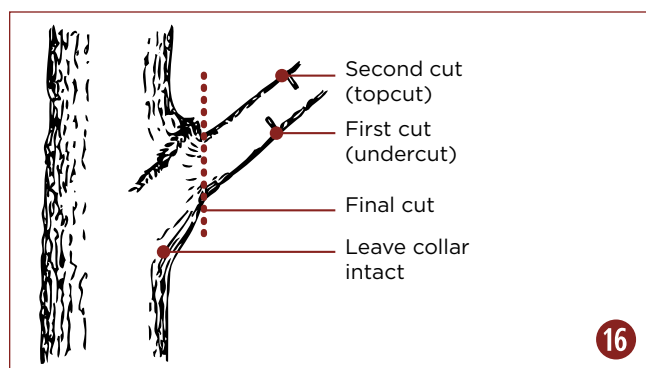Removal cut

15
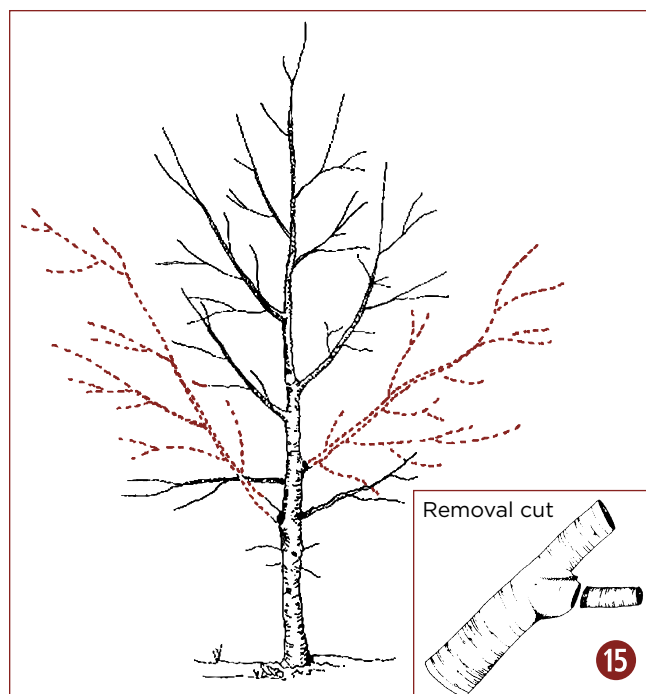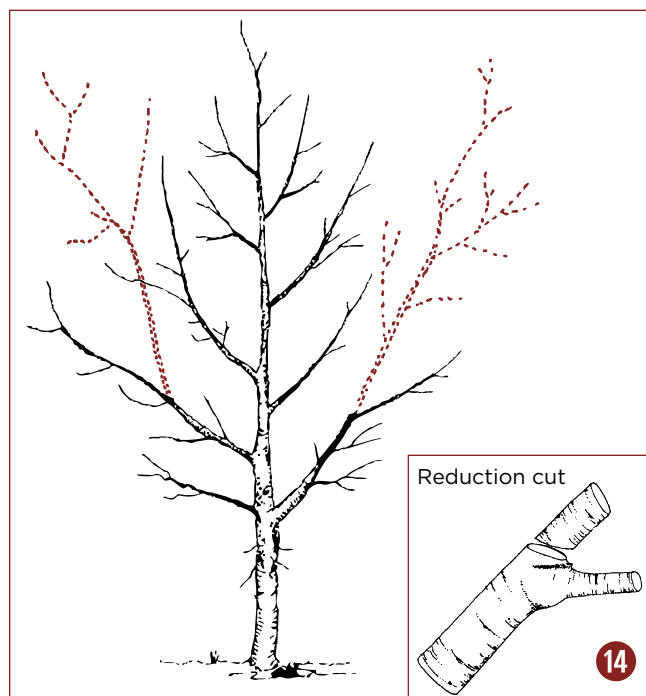
Figure **14**

A reduction cut shortens the length of a stem by pruning back to a smaller limb large enough to assume dominance.
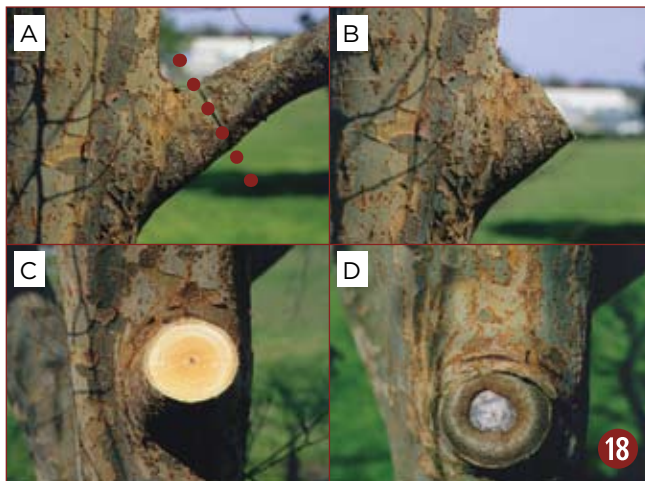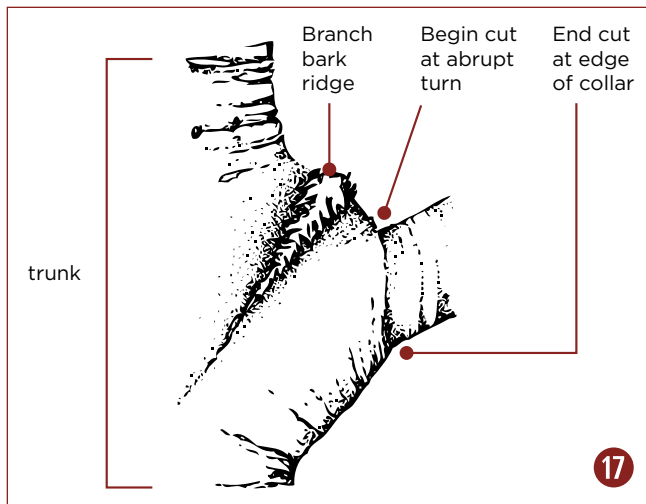
Figure **15**

A removal cut prunes a branch back to the trunk or parent branch.

Figure **16**

There are three steps to making a proper pruning cut that will minimize damage to the tree.

Second cut (topcut)

First cut (undercut)

Final cut

Leave collar intact

16

Branch bark ridge · Begin cut at abrupt turn · End cut at edge of collar · trunk

17

19

A · B · C · D · **18**

20

Figure 17

A close-up illustration showing where to make a removal cut.

Figure 18

A proper removal cut is made by cutting on the dotted line (A). When done correctly, a removal cut leaves the collar intact (B). The wound from a removal cut should be round in shape (C). Callus formation around a proper removal cut wound should be symmetrical (D). A good way to teach yourself and others how to properly prune is to practice making cuts to look like C and D.

Figure 19

The "yes" (dotted) line represents an appropriate removal cut. Cutting through the "no" (solid) line cuts through the collar and represents a flush cut.

Figure 20

Flush cuts remove the top of the branch bark ridge, and typically expose more bark on top of the cut than on the sides and bottom (top). Flush cuts prevent the wound from sealing over properly, and typically close first on the sides then on the top and bottom (bottom). Severe decay can occur behind flush cuts, especially large ones.

Pruning Plans

With six to seven pruning events in the first 25 to 30 years after planting, a good structure can be developed that will place the tree on the road to becoming a permanent fixture in the landscape. Less frequent pruning may be required if good quality nursery trees were planted with a dominant leader and trees were irrigated appropriately until established. However, even well structured nursery trees will require regular pruning after planting. The following is an example pruning program for the first 30 years of a tree's life.

First Five Years after Planting

In the first five years after planting, most of the branches are temporary; however, do not remove more than 35% of the live foliage at any one pruning visit. This will minimize any stress the tree may experience from loss of foliage. Reduce all branches greater than 1/2 the diameter of the trunk. Select one stem to be the leader, and reduce or remove all branches competing with it. Reduce and/or remove large, vigorous branches low in the canopy, and remove any broken, cracked, or severely damaged branches. The pruning cycle and dose for these first five years should be determined individually for each tree type and size—for example, a pruning visit could be scheduled for year two and year four, or only one visit may be necessary during this period.

Five to Twenty Years after Planting

During this portion of the pruning program do not remove more than 25-30% of the live foliage at one time. Select the lowest permanent limb in the canopy and reduce/remove branches lower than this. Continue to reduce all branches greater than 1/2 the diameter of the trunk. Identify the largest scaffold limbs of the permanent canopy and reduce all branches within 18 inches of these. Reduce branches with included bark, and reduce or remove competing leaders. This can be done in stages if there are more than three competing leaders. Again, the pruning cycle will vary. At least three pruning visits should be scheduled during this period.

Twenty to Thirty Years after Planting

Remove all branches below the first permanent limb by twenty to thirty years after planting. Identify 5-10 permanent scaffold limbs, and reduce branches within 18-60 inches of these to avoid clustered branches. Continue to prevent the development of defects by reducing branches with included bark and those branches competing with the main leader.

Additional Reading

Illustrated Guide to Pruning
Gilman, E. F. 2002. , 2nd edition. Delmar Publishers, Albany NY.

Landscape Plants
http://hort.ifas.ufl.edu/woody/pruning